REMARKS

Applicant would like to thank the Examiner for the careful consideration given the present application. The application has been carefully reviewed in light of the Office action. Favorable reconsideration of the application is hereby requested in view of the comments made herein.

Claim 5 was rejected under 35 U.S.C. 112, second paragraph, as being indefinite. Accordingly, claim 5 has been amended herein to cure any indefiniteness. Withdrawal of this rejection is respectfully requested.

Independent claims 1 and 8 have been amended herein to include dictionary and/or art recognized definitions known at the time of filing of the present application for the claimed rudder. Thus, no new matter is added by the present amendments. See MPEP 2163.07. As known to those skilled in the art, outboard motors, such as the one disclosed in JP 59-045295, do not have rudders. In watercrafts having outboard motors, rudders are unnecessary for steering as the change of direction of thrust efficiently changes the heading of the boat. Excerpts from several articles discussing the differences between inboard steering and outboard steering are enclosed for the Examiner's convenience. As discussed in the articles, one skilled in the art of watercrafts would understand the term rudder to be an inboard vertical blade that is pivotable about a vertical axis thereof to facilitate steering of the watercraft.

Claim 8 was rejected under 35 U.S.C. 102(b) as being anticipated by JP 59-045295 (JP '295). Traversal of this rejection is made for at least the following reasons. JP '295 is

directed to a watercraft with an outboard motor, not a rudder. The Examiner contends that the outboard motor of JP '295 is equivalent to the claimed rudder "because the lower cowl structure of an outboard motor functions as a rudder." However, Applicant is not claiming the function of a rudder. Rather, Applicant explicitly claims a rudder, which was known to one skilled in the art at the time of filing to be a non-motorized inboard structure that is coupled to a steering mechanism (e.g., a steering wheel) via a steering linkage bar. In contrast, JP '295 discloses an outboard motor coupled to a steering lever. Thus, JP '295 is lacking at least one of a steering mechanism and a steering linkage bar. Because JP '295 does not disclose each and every element as set forth in claim 8, JP '295 cannot anticipate claim 8. Withdrawal of this rejection is requested.

Claims 1-11 were rejected under 35 U.S.C. 103(a) as being unpatentable over JP '295 in view of Ziehm (U.S. Patent No. 6,201,483). Traversal of this rejection is made for at least the following reasons. As discussed above, the claimed rudder is absent from JP '295, which only discloses an outboard motor. Further, JP '295 is missing at least one of a steering mechanism and a steering linkage bar, which is coupled between the steering mechanism and the rudder.

Ziehm is directed to a steering position indicator for a boat, which includes a signal to indicate when the boat's steering control means is centered with respect to the boat's centerline. As indicated in the Background of the Invention section of Ziehm, the visual indicator is needed because "[a]t slow speed, it is often difficult for the operator to tell the left/right position of the boat's steering means") Col. 1, lines 19-21. Because JP '295 is

directed to a watercraft having an outboard motor, the problem of determining the left/right position of the steering means is non-existent as the steering means/outboard motor is readily visible to the operator. For this reason, one would not have been motivated to modify JP '295 with the teachings of Ziehm in the manner contended by the Examiner.

The Examiner stated that "[i]t would have been obvious for one skilled in the art at the time of the invention to connect an indicator light to the center-detecting swith of JP ('295) ... to alert the operator of a malfunction in the tilting apparatus of the outboard motor." The Examiner explained that "if the tilting mechanism failed to respond even when the indicator light was illuminated, it would clearly indicate a malfunctioning of the tilting mechanism." Applicant strongly disagrees. As stated above, the position of an outboard motor is readily visible to an operator. If the tilting mechanism of the motor failed to respond, it would be clear to the operator that there was a malfunction in the tilting mechanism without the need for an indicator light, as the operator would be able to clearly see that the motor was centered. To provide an indicator light to show the position of a structure where that position is clearly visible to the naked eye is unnecessary and undesirable, as it adds expense to the structure. The center detecting switch of JP '295 is not provided as an indicator to an operator, but rather as a safety measure so that the outboard motor is prevented from being tilted when it is not centered.

The Examiner further contends that one skilled in the art would have provided an indicator light to the structure of JP '295 in order to provide a navigational assist mechanism for guiding the watercraft in a straight direction in poor visibility conditions. If one skilled in

the art needed a navigational assist mechanism for a watercraft with an outboard motor, it is submitted that one would just provide a light on the watercraft such that the operator could view all positions of the motor, rather than just a centered position. Additionally, when steering an outboard motor, the operator typically stands very close to the motor such that even in poor visibility conditions, the operator is able to see the motor and, in turn, the position of the motor.

For at least these reasons, one skilled in the art would have found no motivation to make the proposed combination of JP '295 and Ziehm. Withdrawal of this rejection is requested.

In consideration of the foregoing analysis, it is respectfully submitted that the present application is in a condition for allowance and notice to that effect is hereby requested. If it is determined that the application is not in a condition for allowance, the Examiner is invited to initiate a telephone interview with the undersigned attorney to expedite prosecution of the present application.

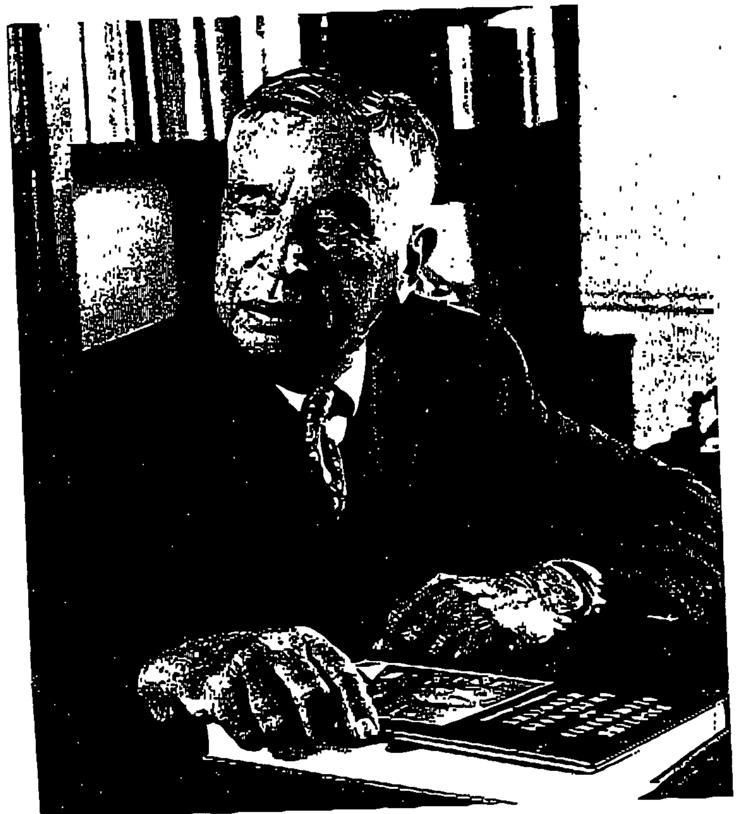
If there are any further fees required by this communication, or if no check is enclosed, please charge such fees to our Deposit Account No. 16-0820, Order No. 36185.

Respectfully submitted,
Pearne & Gordon LLP

Una L. Lauricia, Reg. No. 48998

1801 East 9th Street
Suite 1200
Cleveland, Ohio 44114-3108
216-579-1700
December 8, 2005

CHAPMAN



CHARLES F. CHAPMAN

PILOTING
SEAMANSHIP AND SMALL BOAT HANDLING

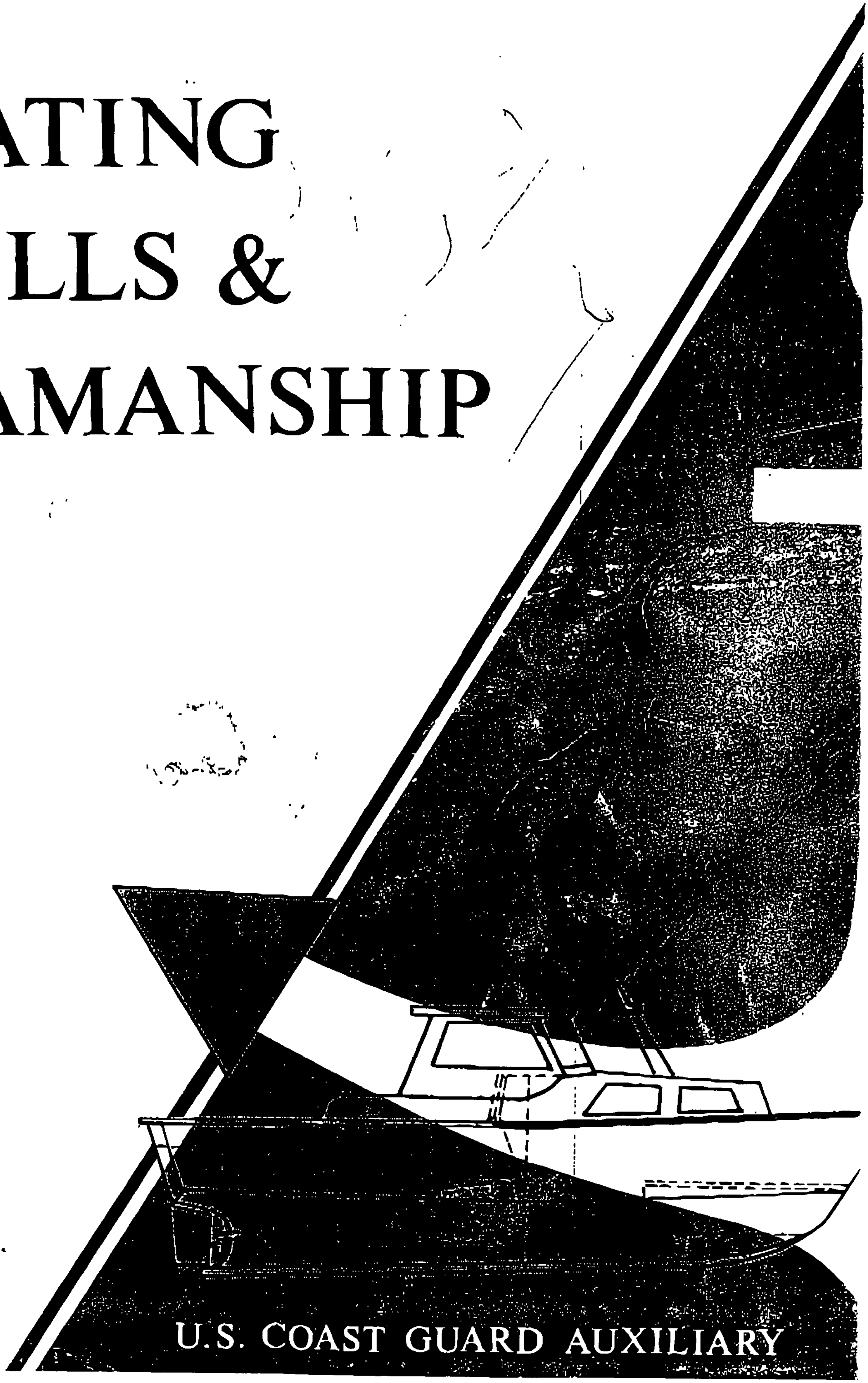
By ELBERT S. MALONEY

54th EDITION

HEARST BOOKS
New York

MOTOR BOATING & SAILING

BOATING SKILLS & SEAMANSHIP



EIGHTH EDITION

U.S. COAST GUARD AUXILIARY

Again, when such a boat has headway, the bow apparently wants to turn to port if the rudder is held amidships, so a certain amount of right rudder may be necessary to maintain a straight course. To correct it, a small trimming tab may be attached to the after edge of the rudder and bent to an angle that provides the proper correction. The effect is a great variable, so small in some cases as to be negligible; quite pronounced in others.

HOW THE RUDDER ACTS

The conventional arrangement for steering on most inboard boats a vertical rudder blade at the stern pivoted in hangers or on its own stock so that movement of the steering wheel or tiller throws it to port or starboard.

Steering gears on motor boats are almost invariably rigged today so that they turn with the rudder, that is, turning the top of the wheel to port throws the rudder to port. Consequently, with the usual rig, the boat having headway, putting the wheel over to port gives her left rudder which kicks the stern to starboard so that the bow, in effect, moves to port. Conversely, turning the wheel to starboard gives her right rudder, throwing the stern to port so that the boat turns to starboard.

Sailboat rudder action

In a sailboat, or auxiliary, fig. 810, when the engine is not driving a propeller, when the boat has headway water flows past the hull and if the rudder is moved to one side of the keel a resistance on that side is created together with a current at an angle to the keel. The combined effect is to throw the stern to port with right rudder, to starboard with left rudder.

But note that *any control from the rudder is dependent on the boat's motion through the water.* Even if she is drifting, with motion relative to the bottom, but none so far as the surrounding water is concerned, her rudder has no effect. Only when the water flows past the rudder and strikes it at an angle does the boat respond. The faster she is moving, the stronger the rudder effect. It makes no difference how her headway has been produced—she may even be in tow—there is control as long as there is motion relative to the water.

FIG. 815 With an outboard motor, the basic principles do not apply. Directed thrust from the pivoting lower unit is used for steering; there is no rudder.

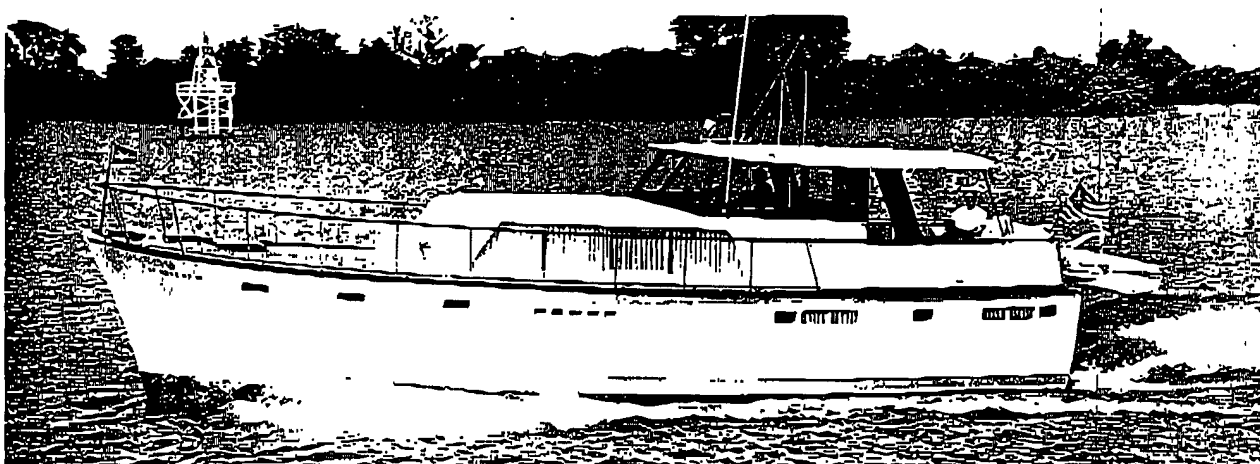
Propeller current's action on rudder

In a motor boat the situation is different from that encountered in a sailboat. Here the rudder blade is almost invariably directly in the discharge current of the propeller which is pumping a strong stream of water astern. Moving the rudder to one side of the keel deflects the stream to that side. The reaction which pushes the stern in the opposite direction is much stronger than it would be in the absence of that powerful jet.

At very slow propeller speeds the boat's headway may not be sufficient to give good control over the boat if other forces are acting upon her at the time. For example, with a strong wind on the port beam, even with rudder hard over to port, it may not be possible to make a turn into the wind until the propeller is speeded up enough to exert a more powerful thrust against the offset rudder blade.

Here is a fundamental principle to remember in handling motor boats. In close quarters a motor boat can often be turned in a couple of boat lengths by judicious use of the power. If, for example, the rudder is set hard to starboard (that is, right rudder) while the boat has no headway and the throttle is suddenly opened, the stern can be kicked around to port before the boat has a chance to gather headway. The exact technique of turning in limited space will be described in detail further along.

FIG. 814 On inland waterways, boats may get into shoal water. This reduces the speed and also affects their handling qualities, response to the rudder being sluggish.



to a point just ahead of the other vessel's pilot house. The angle of approach to the other vessel should be small. If it appears that the angle is too wide the helm should be used decisively to place her in position in plenty of time to straighten out.

With reduced speed, the helmsman handles the wheel smartly, using considerably more helm to achieve a given response than he would need if the vessel had good headway. What he does is to get the bow to swing, then shifts the rudder smartly for a moment, then shifts back to the midships position.

Engines are kept stopped (or idling, as the case may be) as she comes in at a moderate angle, her bow about six feet from that of the other vessel. A bow spring is passed, slack taken up and secured. Now the outside (starboard in this case) engine is backed 1/3 while the inside (port) engine goes ahead 1/3. This is just a momentary kick to be repeated if necessary.

The effect of the reversing outside engine is to kill the headway and swing the stern to port toward the other vessel, assisted by the kick ahead on the inside engine. The last of the headway, acting on the spring, also contributes to the same effect. No heaving lines have been used during this maneuver and, under ideal conditions, only the outside engine will be called on for a short kick astern while the inside engine may not be needed at all.

Outboard and I-O Handling

Boat handling with outboard motors or inboard outboard (I-O) drives in Class A and Class I craft is quite different from the procedures and techniques discussed earlier in this chapter for inboard craft. The skipper who makes a too quick and brash change from inboards to outboards may find himself severely embarrassed. This is true whether he had a single- or a twin-screw inboard boat, and whether he has one or two outboard motors or outdrives. (Boats propelled by outboard motors and I-O drives have essentially the same handling characteristics; for the balance of this chapter, the two types will be considered together with the terms used interchangably.)

Major Differences

In a way, boat handling with outboard drives is easier than it is with inboard propulsion, but different, too! There are two differences, each of major importance. First, the direction of propeller discharge current of an inboard boat is always parallel to the craft's keel, although it may be forward or reverse; thrust is parallel to the direction that the boat is *headed*, regardless of the direction that it may momentarily be *traveling*. With a single-screw inboard craft, the thrust line is coincident with the boat's centerline (although angled down somewhat); with a twin-screw inboard, the thrust line of each engine is not coincident with the centerline, but each is parallel to it. On the other hand, with outboard propelled boats the situation is radically different. The thrust line of the propulsion is easily changed from dead ahead or astern to either side. On quite small motors not having reverse gears, thrust can be pointed in any direction through a full 360° circle; on other motors, those with reverse gears, the angle of thrust is limited to perhaps 40° either side of the centerline. It should be noted that the pivot point around which the thrust is rotated is *outside* the boat, just aft of the transom (this ignores a very few specialized boats with interior motor wells). This external turning point of the thrust will combine with the natural turning point of the hull to result in a pivot point for a craft that is highly individualized and must be learned from experience.

No rudder

The second major point of difference between inboard and outboard boats is the *absence of a rudder* on the latter. A rudder is unnecessary for the normal steering of outdrive craft as the change of direction of thrust very efficiently changes the heading of the boat, and consequently its direction of travel. When, however, the outdrive propeller is giving little or no thrust, as when the motor is idling or is stopped, the absence of rudder blade area deprives the skipper of control that he would have with an inboard boat from the flow of water past the rudder as the boat "coasts" along. The lower unit of the outboard does in a small measure act as a rudder, but it is a very inefficient and ineffective one. This lack of positive steering action without engine power is something that must be kept in mind; it is not a major problem, but it can't be overlooked or forgotten.

Torque effect

The propeller shaft of an outboard motor or outdrive is horizontal, and thus this form of propulsion is free of the side-turning tendencies which result from unequal blade pressures as described earlier in this chapter for inboard boats with inclined propeller shafts. Large outboard motors and I-O units do, however, tend to have a *torque effect* from their high rotational power. To correct for this, many such underwater units have a small tab or adjustable exhaust nozzle which can be offset from center to correct for torque effect. Properly adjusted, even the largest motors can be run at high speeds with little or no tendency of the boat to pull to one side.

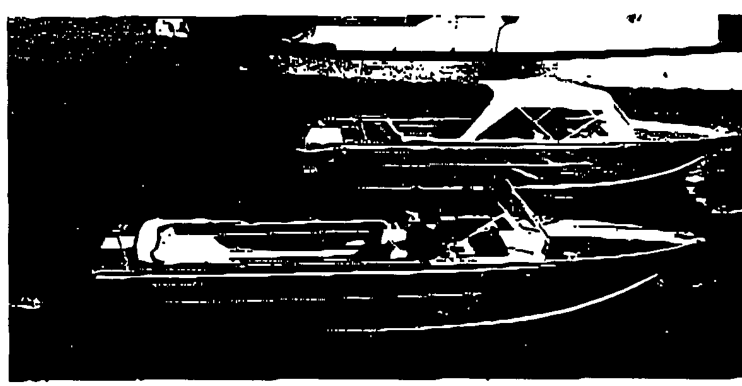


FIG. 871 Boats propelled by outboard motors and those with inboard-outboard drives handle in generally the same manner. Both of these types, however, with their directed thrust and lack of rudders maneuver quite differently than inboard craft.

BELOW—Beneath or under the deck.

FORE-AND-AFT—Lengthwise with the vessel's keel. The opposite to athwartships.

CLOSE ABOARD—Alongside, close to the hull.

FORWARD—Near the bow.

INBOARD—Toward the centerline of a vessel.

OUTBOARD—Away from the centerline of a vessel.

WINDWARD—Toward the wind.

LEEWARD—The direction opposite that from which the wind blows; downwind.

The following terms describe relative directions as viewed *from* a vessel *toward* an object which is *not aboard* the vessel:

AHEAD (Dead Ahead)—In the direction of the vessel's fore-and-aft center line, forward of the bow.

ABEAM—In a direction at right angles to the vessel's keel, on either side.

BROAD ON THE BOW—In a direction half-way from ahead to abeam of the vessel, on either side.

ASTERN (Dead Astern)—In the direction of the vessel's fore-and-aft center line, behind the stern.

BROAD ON THE QUARTER—In a direction half-way from abeam to astern of the vessel, on either side.

Types of Motorboats

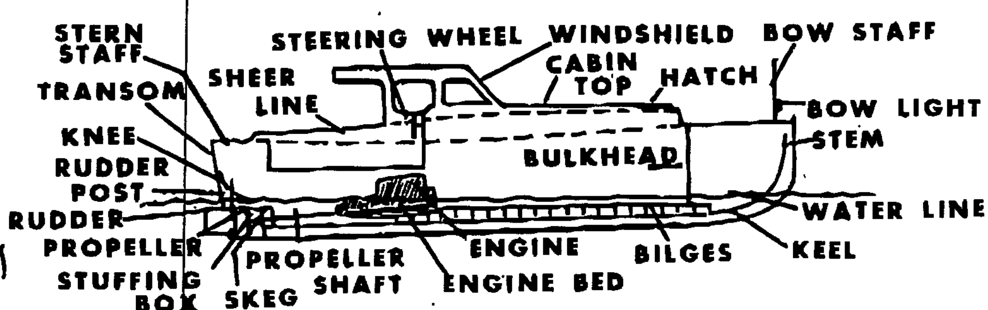
If you are shopping for your first boat, you will find that there is an infinite number of models and sizes on the market. Each has been developed over the years to meet a specific need. Some are adapted to suit specific boating activities and are not suitable for others. So when you select a boat, be sure that it will suit your purposes.

Skiffs are utility boats. They are popular because of their simplicity and durability. Skiffs are flat-bottomed with either straight or slightly flared sides. A skiff is easy to row and may be fitted with a small outboard engine. Because it is flat-bottomed, a skiff is ideal for a hunter or fisherman to operate on protected shallow water.

Prams and Dinghies are small boats with wide beams for their short length. They are intended for rowing but may be fitted with small outboard engines and are used principally as tenders carried aboard larger craft.

Utility outboards are favored by boatmen who rely on outboard engines for power. They are specifically designed for outboard propulsion and consequently are difficult to row. Most utilities are completely open, though some have decked-over bows.

2-4 Utility Outboard

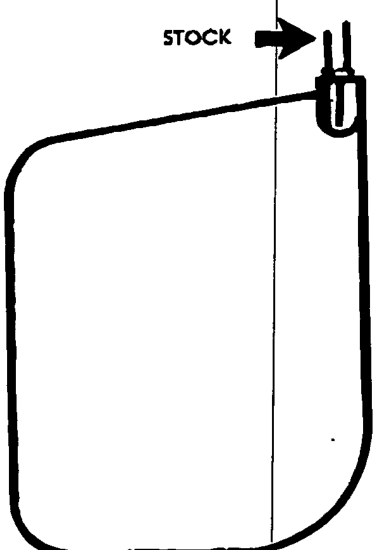


2-3 Sectional Nomenclature.

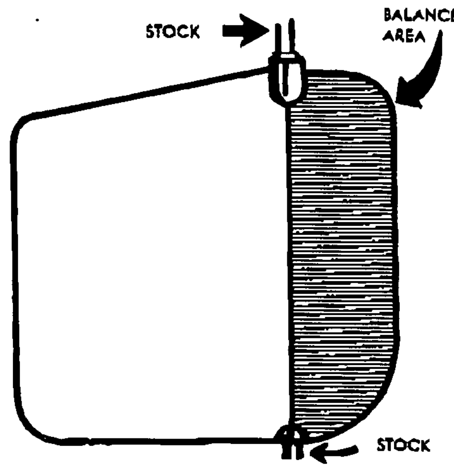
to it and its low speed maneuvering characteristics. A left-handed propeller can cause practical operator problems for one who is used to a right-handed propeller and often requires re-training of the boatman. Twin-screw boats usually have "outboard turning" propellers. This is important in low speed handling characteristics because of the complex interaction of propeller and hull. The explanation of the reasons would be lengthy and technically "deep" but it is a proven fact that *inboard* turning propellers make a boat extremely difficult to handle at low speeds. Twin-screw boats are far more maneuverable at slow speeds than single screw craft. Beside being able to apply varying amounts of power to each propeller separately, the propellers of twin screw boats are placed on either side of the centerline, giving them greater turning leverage.

The Rudder

An inboard powered vessel is steered by means of a vertical blade called the rudder which can be pivoted to either side of the centerline. The size and shape of the rudder have a considerable effect on its operating characteristics. Boats which are designed for relatively slow speeds usually have large rudders, while higher speed boats have smaller ones. The rudder is generally placed directly behind the propeller, or nearly so. Modern twin screw pleasure craft almost always have twin rudders, each of which is placed behind its respective propeller.



3-2 Rudder



3-3 Balanced Rudder

The pivotal shaft to which the rudder is attached is called the stock. On most rudders, the stock is attached to the forward edge of the blade. Certain rudders are designed with a portion of the blade projecting ahead of the stock. These are called balanced rudders. When a balanced rudder is pivoted off the center line, the portion of the blade which is ahead of the stock is placed on the opposite side of the centerline. Although this may be only 15 to 20% of the surface area of the blade, it has the effect of taking a considerable amount of strain off the steering gear and thus makes the boat easier to handle.

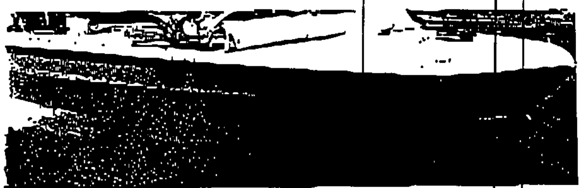
The rudder is another lifting surface. It can be either a symetrical airfoil or a flat plate. As we turn the rudder from its amidships position while the vessel is making headway, it creates a lift, just like an airplane wing, and the resultant force tends to move the stern of the boat sideways.

Even good symetrical airfoil rudders lose their efficiency when turned too far off the centerline, and much of the turning force is lost. It is for this reason that most rudders are limited mechanically to a "hard over" angle of about 35° from amidships.

Practical Effects of Propellers and Rudders

The first thing to remember when operating a powerboat, or any boat for that matter, is the fact that when the rudder is moved off centerline, it is the *stern* and not the bow that changes direction first. This becomes especially important when getting underway (under headway) from a float or pier. Under this circumstance, putting the rudder away

displacement hull is one that achieves its buoyancy otation capability by displacing a volume of water . ıl in weight to the hull and its load, whether under or at rest. A *planing hull*, on the other hand, is one achieves the major part of its load-carrying ability by dynamic action of its underside with the surface of water over which it is rapidly traveling; at rest, a



. 105 A planing hull at high speeds rides more "on" the water ı "in" it. Hydrodynamic forces support the craft rather than dis- ;ement. Friction is reduced and higher speeds are achieved with same horsepower.

.ning hull reverts to displacement buoyancy. A *semi- ·ning* (or *semi-displacement) hull* is one that gets a rtion of its weight-carrying capability from dynamic tion, but which does not travel at a fast enough speed · full planing action. It is often a hull that is round- ttomed forward gradually flattening out toward the ːrn to provide a planing surface.

Sheer is the term used to designate the curve or sweep the deck of a vessel as viewed from the side. The side in of a boat between the waterline and deck is called e *topsides*. If these are drawn in toward the centerline vay from a perpendicular as they go upward, as they ;ten do near the stern of a boat, they are said to *tumble ɔme*. Forward, they are more likely to incline outward ı make the bow more buoyant and to keep the deck rier by throwing spray aside; this is *flare*. See Fig. 108.

The bottom of a boat may be one of three basic shapes —*flat, round*, or vee—or it may be a combination of two hapes, one forward gradually changing to the other ɔward the stern. There are also more complex modern hapes such as *cathedral-hull, deep-vee, multi-step*, and ›thers. See Fig. 109.

The *stem* is the near-vertical major structural member t a vessel's bow. A stem is common to all boats with he conventional type of bow, whereas the square-nosed ›ram or *punt* type has a bow resembling its square stern. ’he stem of a boat is *plumb* if it is perpendicular to the vaterline or *raked* if inclined at an angle for better ap- ɔearance. The term *overhang* describes the projection of :he upper part of the bow or stern beyond a perpendic- ular from the waterline. *Eye bolts* or *ring bolts* are frequently fitted through the stems of small boats for towing or for pulling aboard trailers.

Flat planking across the stern is called the *transom*. If, however, the stern is pointed, resembling a conventional bow, there is no transom and the boat is called a *double-ender*. The *quarter* of a boat is the after portion of her sides, particularly the furthermost aft portion where the sides meet the transom.

Each continuous line of planking along the hull from bow to stern is called a *strake*. The lowest strake, next to the keel, is termed the *garboard strake*. The *gunwale* (pro-

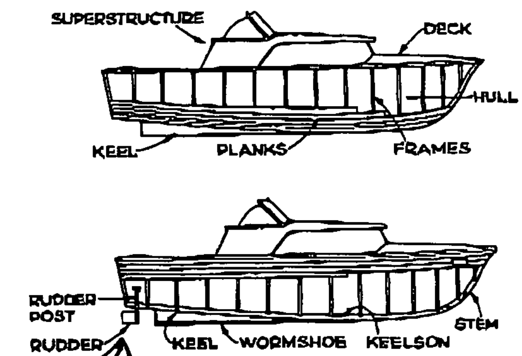


FIG. 106 Principal hull parts. In lightly framed boats what is here designated "keelson" would be the keel, and what is here "keel" would be a skeg. In heavily framed craft, such as tugs and mine-sweepers, the terminology shown here is correct. See page 4.

INBOARD

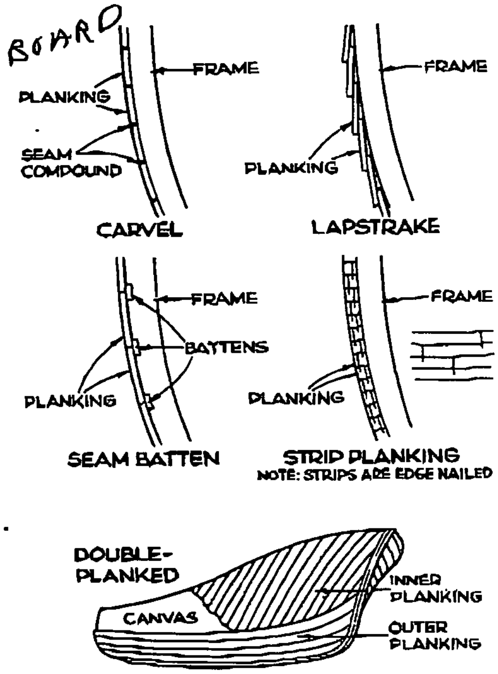


FIG. 107 Planking techniques. When canvas is used between planking courses it must be saturated with preservative, for when it rots the hull must be abandoned. First-class yacht construction formerly used orange shellac as a filler and adhesive between courses of double planking.

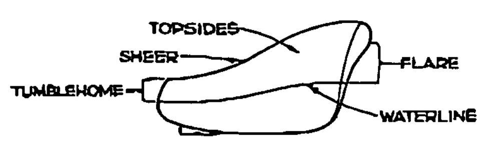


FIG. 108 Flare is the outward curvature of the sides near the bow. It is characteristic of modern designs, providing more usable for-ward deck area and making for a "drier" boat by turning aside spray. Tumblehome is the inward curving of topsides near the stern.

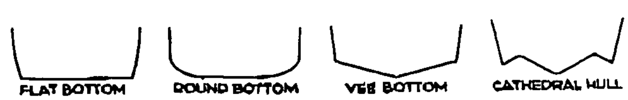


FIG. 109 Different bottom designs are used for various types of boats. A flat-bottom craft is inexpensive to build; a vee-bottom is used on fast craft. The "cathedral" hull is used on many small craft for speed and stability.

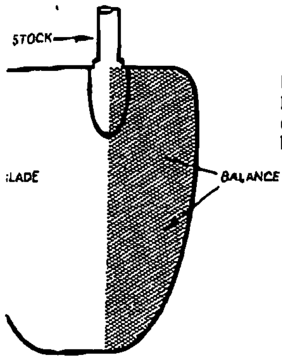
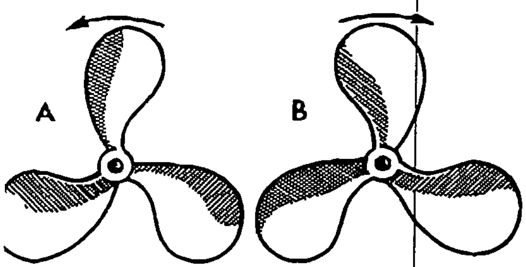


FIG. 806 A balanced rudder, in which part of the blade area (shaded section) projects ahead of the rudder stock.

FIG. 807 Left-hand and right-hand propellers. This is how they turn when you stand astern of them, looking forward at the aft side of the blades.



er cent of the total rudder area, it exerts considerable :t in taking strain off the steering gear and making 'ing easier, though it may slow the boat on a turn ; than the unbalanced type.

RIGHT- AND LEFT-HAND PROPELLERS

opellers are right-handed or left-handed, depending ne direction of their rotation. It is vital that the differ- · be understood because this has a great bearing on a boat maneuvers, especially when reversing. To de- ;ine the hand, stand outside the boat, astern of the ›eller, and look forward at the driving face of the es, fig. 807. *If the top of the propeller turns clockwise n driving the boat ahead, it is right-handed; if counter- :kwise, left-handed!* A is left-handed; B, right-handed. ost propellers on marine engines in single-screw in- ıtions are right-handed although some are left-handed. ny maneuvering problems which follow, the assump- is that the propeller on a single-screw boat under dis-

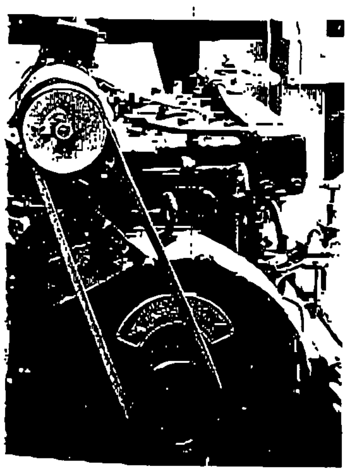


FIG. 808 Direction of rotation is marked on this marine engine flywheel housing. This is a left-hand engine, as shown by the counterclockwise direction of the arrow. It takes a right-hand propeller.

cussion is right-handed unless specifically noted to the contrary.

In twin-screw installations the ideal arrangement is to have the *tops of the blades turn outward* for better maneuvering qualities. In fig. 807 the port engine swings a left-hand wheel, the starboard engine a right-hand wheel.

Don't be confused by the term right- and left-hand as applied to the engines that are driving the propellers. If you stand inside the boat, facing aft toward the engine, fig. 808, and the flywheel turns *counter-clockwise* (as in most marine engines) it is a *left-handed engine* and requires a *right-hand propeller*. A right-hand engine takes a left-hand wheel.

HOW THE PROPELLER ACTS

Motor boats are driven through the water by the action of their propellers which act almost like a pump, drawing in a stream of water from forward (when going ahead) and throwing it out astern. This stream moving astern reacts on the water around it to provide the power for propulsion. Sometimes an analogy is drawn between propeller action and a screw thread working in a nut, but this fails to give a correct picture of what really is happening at the propeller.

Actually all of the water drawn into the propeller does not flow from directly ahead like a thin column of water but for our purposes here it can be considered as coming in generally parallel to the propeller shaft. The propeller ejects it and as it does so imparts a twist or spiral motion to the water, fig. 809, its direction of rotation dependent on the way the propeller turns. This flow of water set up by the propeller is called *screw current*.

Suction and discharge screw currents

Regardless of whether the propeller is going ahead or reversing that part of the current which flows into the propeller is called the *suction screw current*. The part ejected from the propeller is the *discharge current*, fig. 811. The latter is not only spiral in motion but is also a more compact stream than the suction current and exerts a greater pressure than the suction current.

By locating the rudder behind the propeller in this discharge current a greater steering effect is possible than if it were to be placed elsewhere, to be acted upon only by water moving naturally past the hull. For that reason a

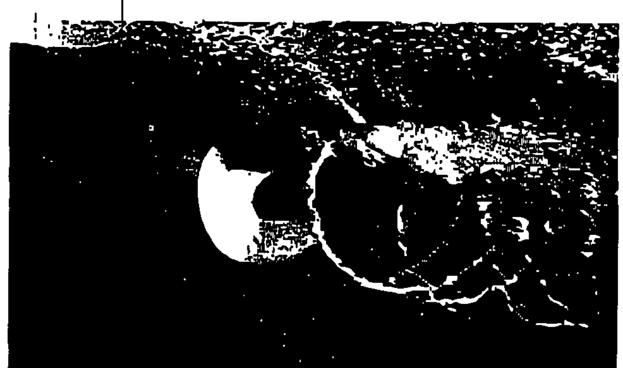


FIG. 809 The discharge screw current from a propeller is given a spiral twist by the propeller blades, as this view of an outboard lower unit shows. A left-handed inboard engine, driving a right-hand propeller, would create an opposite (clockwise) spiral.

ıarge current strikes the starboard side of the hull. You in each of the cases where the discharge current of ·eversing propeller is a factor, the strong current on .tarboard side is directed generally toward the boat's but upward and inward in a spiral movement. The ending blade on the port side, on the other hand, ; to throw its stream downward at such an angle that ›rce is largely spent below the keel. Therefore, the forces are never of equal effect.

ıtil the boat gathers sternway from her backing pro- r it would not matter if the rudder were over to port arboard. The discharge current against the starboard is still the strong controlling factor and the stern is vn to port. (Come back to this later when we discuss natter of turning in a limited space.)

TH STERNWAY, PROPELLER REVERSING

ɪw visualize the boat gathering sternway as the pro- r continues to reverse. Here arises one of the seem- mystifying conditions that baffle many a helmsman ıg his first trick at the wheel. The novice assumes that wants to back in a straight line his rudder must be ·ships, just as it must be when he goes ahead on a ;ht course. Under certain conditions his boat may respond to *right* rudder as he reverses by going to which is exactly what he doesn't expect, and if he is ing by trial-and-error he comes to the conclusion that pends on the boat's fancy, while rudder position has ing to do with control.

t's analyze the situation, however, to see if he's right whether there is anything that can be done about it. ınately, there is.

‹ing with left rudder

the outset we can rule out any effect of wake current ıt force now is spent at the bow. Considering first the obvious case, let's assume we have left rudder. Here are four factors all working together to throw the to port. Unequal blade thrust is pushing the stern ›rt; the discharge current of the propeller is adding ›werful effect; and now we add the steering effect c rudder acting on the aft side of the rudder blade, st which the suction current of the propeller is also ing.

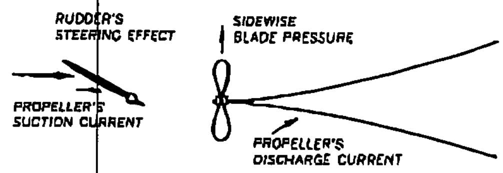
member this condition well for it is the answer to *practically every single-screw vessel with right-hand ›ller naturally backs to port* easily when she may be ıate about going to starboard when reversing, fig. 821.

‹ing with rudder amidships

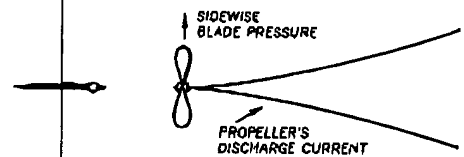
ɪw, while backing to port, let's bring the rudder amid- and see what happens. Here we have eliminated the ts of suction current and steering from the rudder, ıg unequal blade thrust and the discharge current to nue forcing the stern to port.

‹ing with right rudder

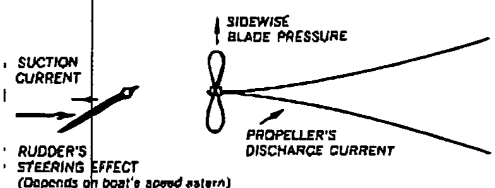
ıuming further that we have not yet gathered much way, let's put the rudder to starboard and see if we possibly make the boat back to starboard as you t expect she should with right rudder. The forces of ual blade thrust and discharge current still tend to her stern to port, but the suction current of the pro-



Boat Backing, Propeller Reversing, Left Rudder — Boat's stern goes rapidly to port



Boat Backing, Propeller Reversing, Rudder Amidships — Boat's stern still goes to port



Boat Backing, Propeller Reversing, Right Rudder — Boat's stern may still go to port though with sufficient sternway and Full right rudder, she should back to starboard

FIG. 821 Three different situations where a boat is backing, her propeller reversing, with rudder set in various positions. Some boats back to port no matter how the rudder is set, but usually with right rudder and good sternway, they can be turned to starboard, though the turn to port is much better.

peller wants to offset this. The effect of the discharge current is stronger than the suction so the tendency is still to port. Now, with sternway, the steering effect of right rudder is to starboard, but as yet we haven't way enough to make this offset the stronger factors.

STEERING WHILE BACKING

Just about the time we are about to give it up on the assumption that she can't be made to back to starboard, we try opening the throttle to gain more sternway. This finally has the desired effect and with full right rudder we find that the steering effect at considerable backing speed is enough (probably) to turn her stern to starboard against all the opposing forces. How well she will back to starboard—in fact, whether she will or not—depends on the design.

All of this means that if the boat will back to starboard with full right rudder, she may also be made to go in a straight line—but not with rudder amidships. There's no use trying. She will need a certain amount of right rudder depending both on her design and the speed. Some boats,

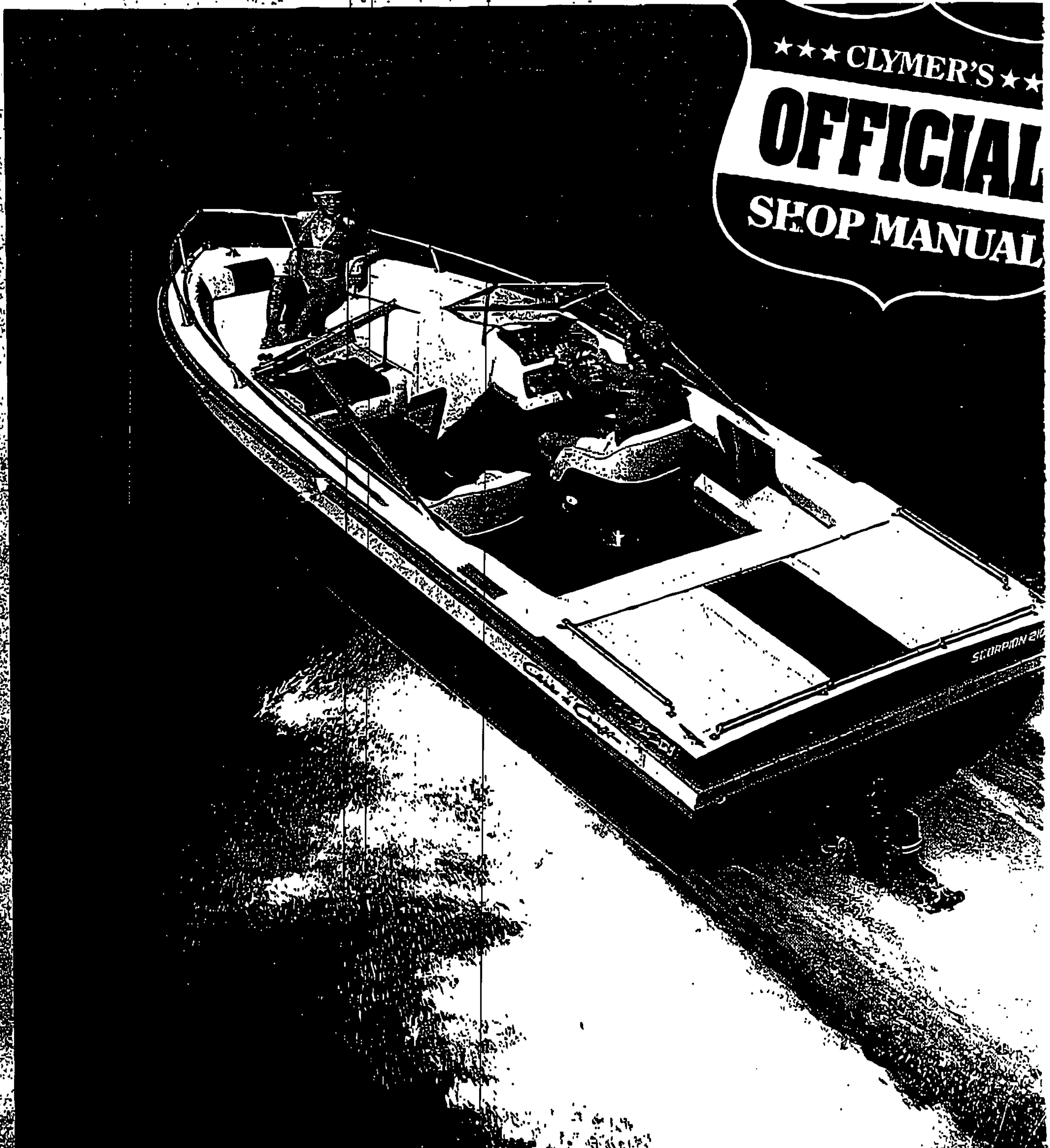
CLYMER

FULL COLOR
Tools & Techniques Section

MERCRUISER
STERN DRIVE SHOP MANUAL

1964-1987

★★★ CLYMER'S ★★★
OFFICIAL
SHOP MANUAL



INBOARD / OUTBOARD

Power Tilt

Chapter Eighteen

I/O

Power Trim and Tilt Systems

The MerCruiser power trim system permits raising or lowering the stern drive unit for efficient operation under varying conditions. Early stern drive units used a mechanical tilt system in the form of a series of holes in the gimbal ring. After the unit was set at the desired angle, an adjustment stud inserted through the appropriate hole held it in place.

This chapter covers three MerCruiser power trim and tilt systems: the high-pressure pump system, low-pressure pump system and auto trim system.

HIGH-PRESSURE PUMP SYSTEM

This MerCruiser power trim and tilt system is electro-hydraulically operated. Its electrical sub-system consists of a power trim control panel or handle, a pump motor and a trim limit switch, with connecting wiring. Some models may also be equipped with a trim indicator sender. **Figure 1** shows a typical system.

The hydraulic sub-system contains a Prestolite or Oildyne hydraulic pump, the trim cylinders, a reverse lock valve and the necessary hoses and fittings. See **Figure 2**.

Electrical Sub-system

Single or dual solenoids may be used according to system application.

Single Solenoid System

A 3-button power trim panel control operates the single solenoid system shown in **Figure 1**. Battery current reaches the solenoid through the red lead, a 90-amp fuse, a 40-amp circuit breaker and the red/purple lead. Depressing the IN button routes current from the red/purple lead to the green/white wire, operating the pump in the down direction.

Depressing the UP/OUT button sends current from the red/purple extension lead through the purple/white lead to the trim limit switch. Current reaching the switch passes through the blue/white lead to the solenoid, where it travels to the trim motor through a larger blue/white lead. The trim motor can provide about 17° of trim before the trim limit switch opens and shuts off current to the pump.

Depressing the UP/OUT and UP switches at the same time allows the current to bypass the trim limit switch. It passes from the red extension lead to the blue/white wire and on to the solenoid to drive the unit to its full up position.

Chapman

YAMAHA Motor co,

This is a schematic of a power tilt stern outdrive. There is no rudder.

#17 on first page is not a rudder shaft.

You change thrust to steer with a stern drive

Rudder steering is controlled by changing flow of water from props over angle of rudders

R.F. gives true rudder angle - straight

required -- beefed up at the keel and thinned at points where little stress is expected.

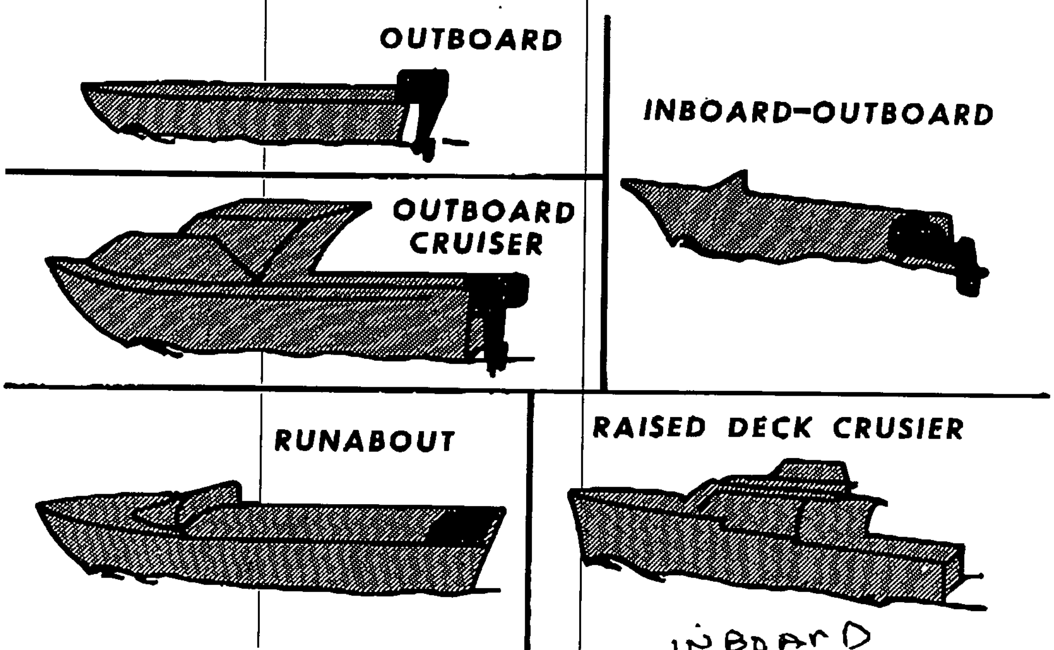
The hull and deck are sometimes one piece, but more often are separate units, joined along the gunwale and sealed with a caulking compound, then riveted or otherwise secured. Interior components, which may be plastic or wood, are usually built outside the hull, then lowered into place and fiberglassed to hull and deck with strips of fiberglass cloth and resin. The bulkheads generally form what few thwartships reinforcements are necessary, and a few longitudinal stringers, either wood or fiberglass, may be added to support machinery as well as strengthen the hull in a lengthwise direction. But the traditional backbone-and-ribcage construction of keel and frames isn't necessary.

Now that fiberglass has been around for three decades, variants on the basic construction method have developed. Because bare fiberglass hulls resonate like drumheads, sound-deadening cores are frequently molded in between the inner and outer layers — especially in decks of larger boats. These cores also help prevent condensation inside the boat. Methods for mechanical molding of smaller hulls, without expensive hand-layup, are now common, and a new type of fiberglass planking (in which glass rods are incorporated in the fiberglass cloth) allows for building larger hulls without a mold. There are even processes that combine resin and wood -- saturating the latter material under pressure with resin.

In spite of long-term uncertainties about the source of petrochemicals from which most fiberglass-reinforced plastics are derived, it seems likely that there will be continued development of this essentially satisfactory material for building pleasure boats.

Aluminum Construction

Aluminum is widely used for hulls and also for superstructures. It is light, strong, fashioned with greater ease than steel, and (when anodized) is corrosion resistant. Aluminum hulls are built in one of two ways. Sheets are bent to the desired shape or they are pressed into shape by hydraulic presses. The resulting plates are welded together or, if riveted, the seams are filled with synthetic caulking compound. "5000" series marine aluminum alloy is extremely corrosion resistant, even in salt water. However, salt water will attack the surface of other aluminums, so it helps to give the hull a coat of paint. Aluminum causes the greatest amount of trouble when it comes in contact with other metals under water. When used adjoining a dissimilar metal, aluminum must be insulated from it in order to prevent galvanic action or electrolysis.



2-10 Types of Boats